Goals and Objectives Workshop Summary
DRAFT

California Department of Transportation

Transportation Asset Management Plan Project

Event Date: December 15, 2016

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1. Overview

This document details the results of the California Department of Transportation (Caltrans) Transportation Asset Management (TAM) Goals and Objectives Workshop held on December 15, 2016 in Sacramento, California. The workshop was held as part of the effort to develop a Transportation Asset Management Plan (TAMP) for California.

California TAMP project stakeholders participated in the workshop to build agreement on shared transportation goals, objectives, and priorities. This interactive workshop resulted in an improved collective understanding of California's TAM goals and objectives, clearer, more focused strategic direction for the development of the TAMP, and identification of prioritized immediate actions. Workshop attendees developed and prioritized a set of TAM strategies during the morning group exercise. The afternoon exercise resulted in a set of priority TAM improvements, as well as "quick hit" improvements that could be implemented in the short term.

The primary output of the workshop was a series of recommendations generated and prioritized by the attendees. The recommendations, shown below in Table 1, are organized into Strategies (high level plans to achieve goals), Improvements (actionable initiatives to support the strategies), and Quick Hit Improvements (improvements that were identified as "easy to accomplish in the short term").

Table 1: Summary of Workshop Recommendations

	Prioritized Recommendations
Strategies	• Implement cross-asset allocation process • Explore pricing to drive modal choices • Apply broader corridor system management plan approaches • Invest in multi-asset projects
Improvements	• Corridor approach to planning to identify environmental, project and other savings, avoiding small, low benefit investments • Consistent life-cycle costing and deterioration models to support project comparison and selection • Improved coordination with local agencies and communities through the use of geographic information systems (GIS) to share condition data and project plans
Quick Hit Improvements	• Invest in technology and people for bicycle and pedestrian programs (e.g., GIS applications and tools) • Establish a process to capture local project needs and priorities (e.g., a process to drive TAM investment based on equity) • Promote TAM success stories (e.g., safety improvements) • Capture information from the public (e.g., identification of potholes or car breakdowns)

2. Workshop Presentations and Discussions

The workshop began with a brief welcome from the Caltrans Statewide Asset Management Engineer and TAMP Project Manager, Mike Johnson, who described the workshop's purpose and objectives and introduced subsequent speakers: Caltrans Director Malcolm Dougherty, the California Transportation Commission (Commission) Executive Director Susan Bransen, and the Federal Highway Administration (FHWA) California Division Administrator Vincent Mammano. Mike asked each to share their perspectives on TAM and the development of the California TAMP.

Director Dougherty offered a perspective on the importance of a strategic approach to TAM, breaking down the silos of traditional program areas (Bridge, Pavement, Traffic Operations) within the State Highway Operation and Protection Program (SHOPP). Specifically, he noted that with limited resources, the TAM program must become more sophisticated in utilization of asset management funding, looking across asset and program silos, and balancing investments across assets and program areas based on shared objectives.

Executive Director Bransen provided a brief explanation of the role of the Commission within the state TAM program, highlighting how the requirements of Senate Bill 486 have changed the role of the Commission, which is now a more integral part of the process. In the past the Commission approved the SHOPP, but was involved in SHOPP development in a review role. Now the Commission has a mandate to adopt state transportation performance goals and measures, against which the SHOPP, TAMP and other core TAM products will be measured for Commission approval.

Administrator Mammano shared the FHWA perspective with workshop attendees. He specifically noted that collaboration between federal, state and local stakeholders is vital to the successful development of the TAMP.

Next, Mike Johnson presented an overview of TAM, and outlined federal and state TAM requirements. This presentation highlighted that transportation assets underpin the economy and lifestyle of California. These assets, built over years of investment, must be maintained to serve the state, its citizens and stakeholders in the future. Pavement, bridges, culverts and Intelligent Transportation Systems (ITS) assets will be the initial focus of the California TAMP, with the objective to add other assets in the future.

Mike shared that TAM is at the center of change, driven by multiple forces and demands, including accountability to the public, data driven communication expectations, legislation, and technology.

In concluding the presentation, Mike discussed the workshop objectives and how they will be used to establish an improvement path for the TAMP development.

2.1. Workshop Process

The workshop included two small group exercises, both focusing on the eight goal areas for California transportation. Workshop attendees were split into eight groups, with each group assigned one of the goal areas previously defined by Caltrans (provided in Table 2 below). The first exercise was designed to develop candidate strategies to support California's transportation goals and fundamental objectives.

Spy Pond Partners presented ideas for the participants to consider, highlighting national and international examples of TAM applications. The presentation included examples of proactive investment in TAM, communication, reporting, data sharing, and emphasis on broader social goals. These examples set the stage for the afternoon group exercise, which was focused on identifying priority improvements for the California TAM.

The second small group exercise was conducted to identify priority TAM improvements that would support the goals, fundamental objectives and strategies. Workshop attendees remained in the same small groups from the first exercise. The groups were charged with developing TAM improvement initiatives that supported the strategies identified in the morning. At the end of each session, attendees voted to prioritize candidate strategies and improvements.

Table 2: California Transportation Goal Areas and Descriptions

Goal Area	Description
Health	The Health goal broadly recognizes the societal benefits from having more healthy transportation modes. The benefits of healthier transportation options may include items similar to the following: • Reduced medical care costs • Improved air quality from reduced emissions • A healthier more productive society

Goal Area	Description
People	A subset of the Sustainability goal, this area deals with improving the quality of life for the people of California, including: • Transportation modal choice • Accessibility • Social equity
Planet	A subset of the Sustainability goal, this area focuses on the transportation impact on the environment, including: • Impacts on plant and wildlife • Impacts on air and water quality • Noise pollution • Utilization of recycled materials
Prosperity	A subset of the Sustainability goal, this area focuses on economic impacts of the transportation system, such as: • Transportation system resiliency (fire, flood, earthquake, etc.) • Freight system competitiveness
Safety	The Safety goal deals with all modes of transportation safety, including pedestrian and construction work zone accidents, as well as aspects of driver behavior, such as impaired driving, use of restraint devices, speeding or aggressive driving.
Stewardship	The Stewardship goal focuses on the maintenance, rehabilitation and renewal (replacement) of physical infrastructure assets, including: • Major assets, such as pavement, bridges culverts and traffic management systems • Other assets, for example signs and highway lightings • Maintenance facilities, traffic management centers, rest areas • Other activities, such as emergency repairs and relinquishments
System Performance	The System Performance goal focuses on how well the transportation system functions, including: • Travel time reliability • Reduction in travel delay • On time operation for transit • Facilities for bicycle and pedestrian modes (e.g., Complete Streets) • Traveler information systems • Promotion of multi-occupant vehicle trips

2.2. Goal Area Summaries

The following tables show the results of the workshop sessions for each transportation goal area. The tables include updates to the goal area, strategies for achieving objectives, and improvement actions.

Table 3. Health Goal Area Summary

Goal Area: Health	
Goal Area, Fundamental Objectives, and Example Measures Discussion	• Goal = Need broader interpretation of Health • Expand to provide safe attractive convenient transportation network • Expand to address accessibility
Strategies for Achieving Fundamental Objectives	• Add Education • Maintain asset in a way that encourages and doesn't preclude walking/hiking • Create opportunity/ensure practices are not disruptive (especially when working on State Highway System (SHS) or National Highway System (NHS)) • Figure out needs of communities – create a different approach/process for working with communities • Integrate local plans and designs • Support moving people from communities to transit and to jobs. Prioritize critical access points, especially for rural areas (storms create disruption to communities/access)
TAM-Related Action Discussion	• Communication with regional, local agencies and communities before, during, and after projects • Take your list of high priority asset needs to your regional, local community to understand the other needs on those corridors, as well as other improvements • Prioritizing between communities, use metrics based on transportation specific needs, communities with greatest need would rise to top

Table 4. People Goal Area Summary

Goal Area: People	
Goal Area, Fundamental Objectives, and Example Measures Discussion	• Maximize active transportation options
Update to Base Material	• Increase transportation options • Provide access to increased transportation options
Strategies for Achieving Fundamental Objectives	• Develop an integrated bicycle and pedestrian plan between state and local partners. Provide connectivity to these options • Provide infrastructure to promote alternative forms of transportation. Increase charging stations; provide access to transit options • Support and train staff to include multimodal options in the plan, specification and estimate plan, specification, and estimate (PS&E) stage
Measures that Support Goals and Objectives	• Increase the number of bicycle lanes from a baseline • Increase the number of charging stations from a baseline

Table 5. Planet Goal Area Summary

Goal Area: Planet	
Goal Area, Fundamental Objectives, and Example Measures Discussion	• Reduce greenhouse emissions (Senate Bill 375) • Improve water quality • Increase use of recycled materials • Reduce impacts on plants and wildlife
Strategies for Achieving Fundamental Objectives	• Zero-emission vehicles for agencies • Zero-emission infrastructure • Encourage infill and mixed use development • Promote multi-modal travel • Stabilize slopes and revegetate • Increase litter enforcement • Expand litter control efforts • Encourage innovation for use of recycled materials that do not impact life-cycle or safety

Table 6. Prosperity Goal Area Summary

Goal Area: Prosperity		
Goal Area, Fundamental Objectives, and Example Measures Discussion	• Diverse Businesses, industries/efficiencies • Many kinds of prosperity • Access to job, education, and services for households • Agricultural 'product to market' • Overlap with system performance • Variability of economic activity • Tourism – antiquated rural highways influence economic dependency • Mode shift to take pressure off SHS • Rail X Example • Flood protection planning, storm water flood management	• Smaller routes going through urban areas, complete streets linked to prosperity • Local partner to do more, pre-Project Initiation Document (PID) phase evaluation of needs • What are the SHOPP responsibilities? • Freight load capacity percent clearance • Freight system prioritization, biggest bang for the buck is in large urban area • 31 different SHOPP programs – pilot programs • More efficient routing • Take a full corridor analysis • Clear interstate system first
Update to Base Material	• Needs of communities not on network include: – Complete streets – Freight – Goods and Services – Education – Markets	• Variations among communities include: – Households – Businesses – Commuters – Regions – Globally
Strategies for Achieving Fundamental Objectives	• Shift modes in freight to reduce demands on the system • Corridor view, partnerships to achieve multi-objectives • Pricing to ensure mode shift • Increase sustainability awareness in everyday practices • Develop innovation to improve resilience • Design guidance for resilience • Construction innovation, streamlining the lengthy time to define complex projects such as bridges	
TAM-Related Action Discussion	• Corridor approach – frontage road, safety • Partnership with locals	

Goal Area: Prosperity	
TAM Improvements	• Pre-PID outreach to local partners – very early phase consultation. Capture savings with unified planning design and environmental. Counties or locals could lead • Evaluate viability of multimodal (complete streets) components in different contexts – Baseline pedestrian safety improvements vs "deluxe" walkability (reference to smart mobility framework) • Creation of truck-only lanes (under study in the Southern California Council of Governments region) and other pricing strategies (Highway 60 for example) • Coordination between SHOPP and statewide transportation improvement program (STIP) possibly using GIS/visualization • Don't do separate little projects with high environmental costs –incorporate into larger efforts

Table 7. Safety Goal Area Summary

Goal Area: Safety	
Goal Area, Fundamental Objectives, and Example Measures Discussion	• Talking about saving lives • How does asset management tie to safety? • Goal of working towards zero fatalities • Not a direct relationship between safety and asset management (other than demand for money)
Update to Base Material	• Look for ways to classify performance measures by types of roads, e.g. class 1, 2, 3 roads or road owner • Identifying non-standard features and geometric deficiencies
Strategies for Achieving Fundamental Objectives	• Look more in depth at data such as ideas listed above • More access to accident data; better, more timely, accurate data • Need to know where specifically the accidents are occurring

Goal Area: Safety	
TAM Improvements	• Incorporate assets in road projects that communicate with vehicles to promote safety (e.g., roadway direction, upcoming attributes); could also inform law enforcement • Promote sharing of successful safety attributes in asset management among region or among states; no current mechanism • Encourage road network and asset attribute mapping overlaid with current, accurate safety data on systems to identify correlations and opportunities • Correlate maintenance activities on the roadway with how this may relate to safety (e.g., repairing same guardrail that keeps being involved in accidents) • Create system for road users to provide data on issues to identify asset-related safety concerns (e.g., picture with location of pothole, common vehicle breakdown locations) [Waze, ESRI Collector] • Identify opportunities to improve road safety design features to reduce crash severity, not necessarily just to prevent crashes.

Table 8. Stewardship Goal Area Summary

Goal Area: Stewardship	
Goal Area, Fundamental Objectives, and Example Measures Discussion	• SHOPP is generally preserving. Caltrans does not do preventative work on ITS • For ITS, there is constant updating, which is not rehabilitation or preservation work • For culvert health, Caltrans does preventative and repair work, but does not have complete inventory • There is a cost liability risk on culverts related to meeting water standards for the Clean Water Act • Need cross-asset allocation method for money management and return on investment
Strategies for Achieving Fundamental Objectives	• Need cross-asset allocation methods • Need to be able to address all assets during project planning • Need flexibility to include state/local dollars in projects to address assets, to optimize efforts

Goal Area: Stewardship	
TAM-Related Action Discussion	• Align priorities of state and local community to develop multi-objective goals • Deterioration models, life-cycle costs to optimize capital costs but how to prioritize vs. other goals – health, safety? • Optimize asset management within constraints of available funds and propel planning/programming locally • Communicate, share proposed projects with local entities • Share conditions with locals and public • Share data online using GIS • Communicate goals with locals–federal and state requirements

Table 9. System Performance Goal Area Summary

Goal Area: System Performance	
Goal Area, Fundamental Objectives, and Example Measures Discussion	• How recurrent congestion impacts travel time reliability – If not in other focus area then needs to be • Need to define what the system is/includes
Update to Base Material	• Improve travel information • Corridor model choice/options
Strategies for Achieving Fundamental Objectives	• Develop and implement corridor management plans (corridor broadly defined). Operational and analysis–auxiliary lanes, check points, etc. Define what we want in corridor and where • System performance and operational elements, such as congestion management system (CMS), loops, meter health to improve/maintain travel time reliability • Ensure bicycle and pedestrian needs are considered in projects (scoping) when feasible • Provide options for travel time choice within corridors (mixed logit models (ML), priced MLs, freight options)

Goal Area: System Performance	
TAM-Related Action Discussion	All: by district, metropolitan planning organization (MPO), county, regional transportation planning agencies (RTPA) • Analyze gaps–ITS network, e.g., Variable Message Sign • Identify locations for high occupancy vehicle. And toll lanes • Identify bicycle/pedestrian gaps "consensus driven" • Study managed lanes and pricing schemes • Study multi-modal deficiencies • Evaluate each project in relationship to plans, ITS, managed lanes, bicycle/pedestrian/transit, etc. • Connect all plans and suggested improvements from plans onto Central Mapping tool to ensure scope incorporated where warranted • Incentive programs–better land use decisions that keep development moving forward • House association incentives, for ride sharing/commuter programs

2.3. Prioritized Strategies

Each participant prioritized their top three strategies across all goal areas. Based on feedback from all participants, the top four strategies are:

1. Conduct cross-asset resource allocation
2. Explore using pricing as a strategy for modal choices
3. Apply corridor system management plan approach more broadly, including broad definition of corridor
4. Invest in multiple assets/projects

2.4. Prioritized Improvements

Participants prioritized their top three strategies across all goal areas. Each participant used stickers to identify their top five priority improvement actions, as well as a single action that should be considered as a "quick hit" (most easy to accomplish in the short term) action. The results of the exercise and prioritization identified the following three clear priorities for TAM improvements:

1. Implement a corridor approach to planning to identify environmental, project and other savings, avoiding small, low benefit investments

2. Develop consistent life-cycle costing and deterioration models to support project comparison and selection
3. Improve coordination with local agencies and communities through the use of GIS to share condition data and project plans

In addition to these three priorities, four improvement recommendations were identified as "quick hit." These included:

1. Invest in technology and people (e.g., GIS) for bicycle and pedestrian programs (5th overall priority)
2. Establish a process to capture local project needs and priority, for example a process to drive TAM investment based on equity (7th overall priority)
3. Promote TAM success stories (13th overall priority)
4. Capture information from the public, for example identification of potholes or car breakdowns (10th overall priority)

2.5. Workshop Wrap-Up

Mike Johnson concluded the workshop with a summary of the key themes that emerged from the discussion and exercises. These are as follows:

- **TAMP Goals and Objectives:** there was general agreement that the set of goals and objectives presented at the workshop, which is consistent with Caltrans' Strategic Management Plan, should be used to guide TAMP development.
- **Linking Goals and Objectives to TAM:** a basic challenge Caltrans faces is that the set of goals and objectives identified is very comprehensive. It will be a challenge to balance how best to achieve these within the scope of the TAMP given the focus of the TAMP on physical assets such as pavement and bridges. A number of participants emphasized that a TAMP that simply focuses on how to improve NHS pavement and bridge conditions–overlooking goal areas such as People, Planet, Prosperity and Health–will not meet the needs of California or its partners. In short, the TAMP needs to address the full set of goals and objectives. Mike described that application of approaches such as Multi-Objective Decision Analysis (MODA) for the SHOPP will help in this regard.
- **Key Interest Areas:** several areas came up in multiple discussions as areas requiring focus, including:
  - Improving cross-asset resource allocation
  - Better use of IT for sharing information–e.g., clearing houses, GIS data
  - Better corridor planning/incorporation of multiple assets in a project
  - Consideration of "all" needs and local context in projects

- **Linking TAM to Broader Social Goals:** there is a need to further explore innovative approaches linking TAM to broader social goals and include additional criteria besides minimizing agency costs in asset life-cycle planning. European research described during the workshop may be relevant in this regard.
- **Need for Further Dialogue:** as Caltrans proceeds with TAMP development there is a need for further discussion with local agencies, advocates and other stakeholders, particularly regarding the interplay between different objectives discussed during the workshop (e.g., non-recurrent congestion and safety, maintenance improving safety, reducing emissions, and avoiding constraints).

3. Workshop Attendees

Name	Organization
Jeanie Ward-Waller	California Bicycle Coalition
Brian Annis	CalSTA
Amarjeet Benipal	Caltrans
Bijan Sartipi	Caltrans
Bruce De Terra	Caltrans
Carrie Bowen	Caltrans
Coco Briseno	Caltrans
Cris Rojas	Caltrans
David Moore	Caltrans
Ellen Greenberg	Caltrans
Hamid Sadraie	Caltrans
Jennifer Duran	Caltrans
John Gillis	Caltrans
Karla Sutliff	Caltrans
Kathryn McAlpin	Caltrans
Loren Turner	Caltrans
Malcolm Dougherty	Caltrans
Melissa Thompson	Caltrans
Michael B. Johnson	Caltrans
Mike Keever	Caltrans
Nieves Castro	Caltrans
Norma Ortega	Caltrans
Parviz Lashai	Caltrans
Ryan Chamberlain	Caltrans
Shanna Everts	Caltrans
Sharri Bender-Ehlert	Caltrans
Thomas Pyle	Caltrans
Tim Gubbins	Caltrans
Timothy Craggs	Caltrans

Name	Organization
Tong Yang	Caltrans
Rick Guevel	California Transportation Commission
Stephan Maller	California Transportation Commission
Susan Bransen	California Transportation Commission
Arthur Carrera	Alameda County Public Works
Chris Long	Federal Highway Administration
Stephan Gaj	Federal Highway Administration
Steve Healow	Federal Highway Administration
Vincent Mammano	Federal Highway Administration
Westley Rutland-Brown	Federal Highway Administration
Dan Little	Shasta Regional Transportation Agency
Dan Stewart	Stanislaus Council of Government
Kevin Sheridan	San Joaquin Council of Governments
Maura Twomey	Association of Monterey Bay Area Governments
Nick Haven	Tahoe Metropolitan Planning Organization
Rosa Park	Stanislaus Council of Governments
Steve Vandenburgh	Santa Barbara County Association of Governments
Darin Grossi	Tuolumne County Transportation Council
Hank Myers	Transportation Agency for Monterey County
Jerry Barton	El Dorado County Transportation Commission
Luke McNeel-Caird	Placer County Transportation Planning Agency
Scott Lanphier	Colusa County Transportation Commission
James Cameron	Sonoma County Transportation Authority

4. Workshop Background

4.1 Federal Requirements

FHWA recently released a series of rules initiated by the Moving Ahead for Progress in the 21st Century (MAP-21). The rules relevant to the TAMP project are the TAMP rule and pavement and bridge performance management rules. The pavement and bridge rules were in a draft state as of the workshop, but subsequently were finalized on May 20, 2017. These rules are summarized below.

TAMP Rule

The TAMP rule, finalized on October 24, 2016, requires that state Departments of Transportation (DOT) develop TAMPs detailing their asset inventory, current conditions, and predicted future conditions over a ten-year period (using performance measures detailed in the pavement and bridge performance

management rules, respectively).[1] Also, the TAMP should describe the agency's investment plan, address life cycle policies used to manage an agency's assets, and discuss how risk is managed. The plan should include pavement and bridges on the NHS at a minimum, but may include additional assets and/or systems.

One component of the rule is that it requires agencies to use pavement and bridge management systems to support development of the asset management plan, with agencies having documented procedures for the following:

- Collecting, processing, storing, and updating inventory and condition data
- Forecasting deterioration
- Determining benefit-cost over life-cycle of assets to evaluate alternative strategies for managing condition
- Identifying short- and long-term budget needs for managing condition
- Determining the optimal strategies for identifying potential projects
- Recommending programs and implementation schedules to manage the condition of relevant pavement and bridge assets

Pavement and Bridge Performance Management Rule

The pavement and bridge performance management rule was published on January 18, 2017.[2] The rule stipulates that states should establish statewide targets for each of the applicable pavement and bridge condition measures for a four-year performance period for the following measures:

- Percentage of pavement on the Interstate System in good condition
- Percentage of pavement on the Interstate System in poor condition
- Percentage of pavement on the NHS (excluding Interstates) in good condition
- Percentage of pavement on the NHS (excluding Interstates) in poor condition
- Percentage of NHS bridges classified as being in good condition
- Percentage of NHS bridges classified as being in poor condition

The targets should be established in coordination with MPOs, to the maximum extent practicable. States can establish additional targets for any number and combination of urbanized areas and could establish a target for the non-urbanized area for any or all of the proposed measures. MPOs must also establish targets for their NHS bridges, as well as for their NHS pavements.

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[1] Federal Rule Making for Asset Management Plans, https://www.regulations.gov/document?D=FHWA-2013-0052-0064

[2] FHWA Office of Performance Management Pavement and Bridge Condition Performance Measures Final Rule, https://www.fhwa.dot.gov/tpm/rule/pm2.pdf

The rules also specify that states should maintain federally-established, minimum performance levels for Interstate pavements and NHS bridges. The rules propose that if a state fails to meet minimum requirements for consecutive years, it will be required to obligate a specified portion of National Highway Performance Program (NHPP) funds only for eligible NHS pavement and/or bridge projects.

4.2 State Requirements

Caltrans is required by California state law Senate Bill 486 to develop a TAMP, and to establish goals and performance measures for the SHS. Specifically, the law mandates Caltrans, in consultation with the California Transportation Commission (Commission), prepare a "robust asset management plan" to guide selection of projects for the SHS. This asset management plan must be consistent with federal law and adopted by the Commission.

The Commission is also charged to adopt California state transportation performance goals and measures. The adopted goals and performance measures are expected to guide the selection of transportation projects, the performance reporting process, and asset management plan approval by the Commission.

For purposes of this requirement, asset management projects are limited to maintenance, safety, operation, and rehabilitation of state highways and bridges that do not add a new traffic lane to the system.

4.3 Scope of the California TAMP

Based on the above federal and state legislative requirements, California's TAMP must include the full NHS (including local NHS routes) as well as the complete SHS. Specifically, Caltrans has determined the TAMP will include:

- State-owned pavement, as well as other pavement on the NHS
- State-owned bridges, as well as other bridges on the NHS
- State owned culverts
- State owned Intelligent Transportation System (ITS) assets

The NHS consists of roadways important to the nation's economy, defense, and mobility. It includes the Interstate Highway System as well as other roads serving major airports, ports, rail or truck terminals, railway stations, pipeline terminals and other strategic transport facilities. The NHS was developed by the US Department of Transportation in cooperation with the states, local officials, and MPOs.

The California SHS is a network of highways owned and maintained by Caltrans.

Appendix A – Workshop Agenda

California Transportation Asset Management Plan
Goals and Objectives Workshop Agenda
Thursday, December 15, 2016

Workshop Purpose

- Discuss California's transportation goals and fundamental objectives and how transportation asset management (TAM) can support them
- Develop strategies for achieving goals and fundamental objectives
- Develop TAM improvements that will support goals, fundamental objectives, and

Introduction

10:00 AM Workshop welcome, review of agenda and introductory remarks

- Caltrans
- California Transportation Commission
- Federal Highway Administration

Setting the Context

10:20 AM TAM Overview
Federal and State TAM Requirements

Establishing and Aligning Goals, Fundamental Objectives, Strategies, and Measures

10:40 AM California Goals and Fundamental Objectives

- Small Group Exercise – Develop candidate strategies to support goals and fundamental objectives.
- Group Reports
- Prioritization of Candidate Strategies

Noon Lunch

Vision – Examples of TAM Possibilities

1:00 PM National and International TAM Examples

TAM Improvements

1:20 PM How can asset management help us achieve our goals?

- Small Group Exercise - Develop candidate TAM improvements to support California's transportation goals, fundamental objectives and strategies
- Group Reports
- Prioritization of Candidate TAM Improvements

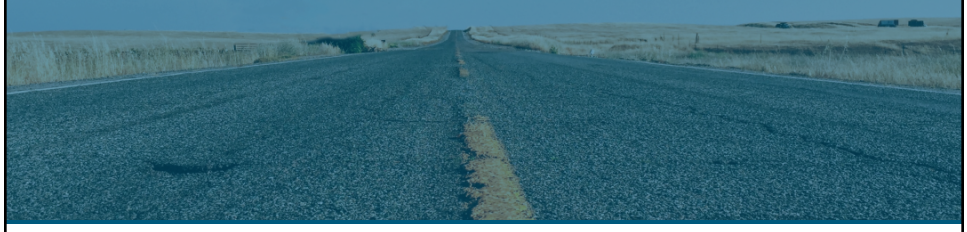
Workshop Wrap Up

2:45 PM Summary of key themes and next steps

Appendix B – Workshop Presentation

California Transportation Asset Management Plan

Goals & Objectives Workshop



December 15, 2016

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California Transportation Asset Management Plan

TAM Overview

Federal and State TAM Requirements

Mike Johnson, Caltrans Asset Manager

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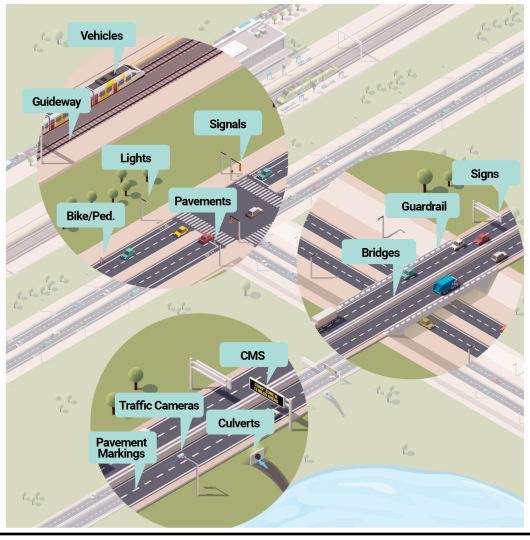
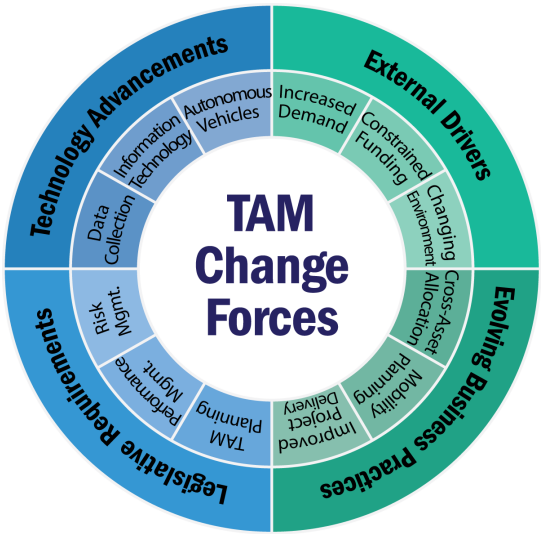
The Importance of Transportation Assets

- Assets underpin our economy and supports lifestyles
- They represent a major investment by the state - progressively built up over a long period
- They spur economic growth and social development

Many Transportation Assets



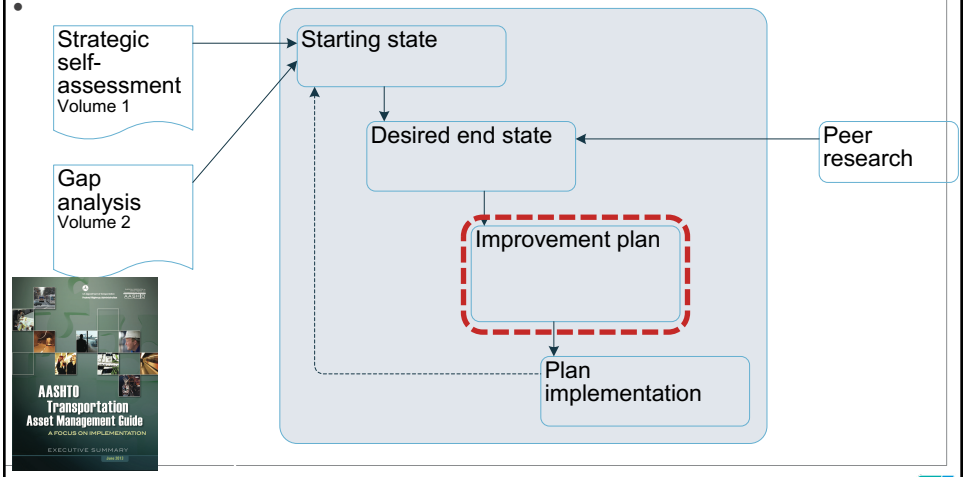
Drivers of Change



Why Asset Management?

- Legislative Drivers
  - MAP-21 requires performance-based budgeting and monitoring
  - California Law (SB486) requires a robust asset management plan
  - Legislative bodies throughout the country are seeking evidence of progress made with funding provided
- Maximize Available Funding
  - Having the information available to make good decisions
  - Life-Cycle Planning
  - Better coordinating efforts across business units
  - Demonstrating asset need with quantitative information is compelling to decision-makers
  - Accountability for public funds

TAM Improvement Path



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California Government Code

- Government Code requires a "robust asset management plan" to guide the selection of projects in the SHOPP.
- The Asset Management Plan shall be consistent with Federal Law
- Performance measures and targets are approved by the CTC
- Projects shall be limited to maintenance, safety, operation, and rehabilitation of state highways and bridges that do not add a new traffic lane to the system
- Applies to the entire State Highway System

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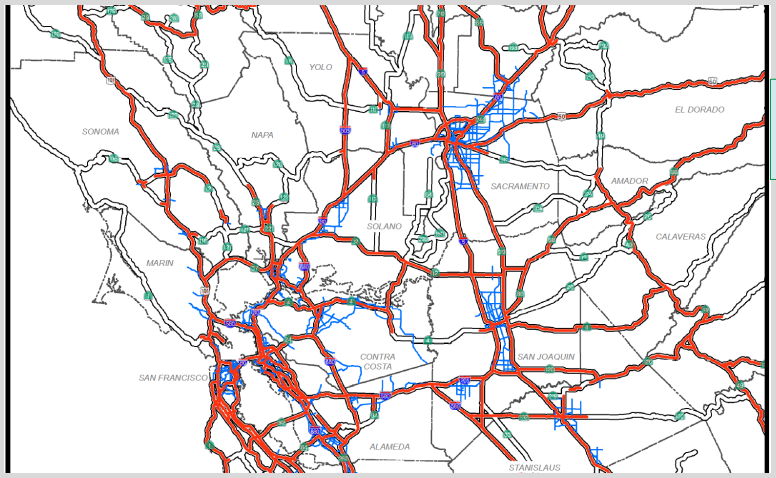
State Highway System (SHS) & National Highway System (NHS)



MAP-21 / FAST Act

- Federal Regulation (MAP-21/FAST Act) requires the development of a Transportation Asset Management Plan (TAMP) with National Performance Measures for pavement and bridges
- The TAMP Requires the implementation of Performance Management which requires performance targets to be set using the National Measures
- TAMP shall include the entire National Highway System

Scope of TAMP

Owner	System	Asset Classes			
		Pavement	Bridges	Culverts	ITS
Local	NHS	Federal Requirements			
State	NHS				
State	Non-NHS			State Requirements	

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MAP-21/FAST
Pavement Performance Management

- Good/fair/poor measure determined based on 4 metrics
  - If all are good the combined measure is good
  - If ≥2 metrics are poor the combined measure is poor
- Need to report conditions and targets for % good and poor for Interstate and non-Interstate NHS
- Rule sets an additional goal of ≤5% poor for Interstates

	Good	Fair	Poor
IRI *(inches/mile)*	<95	95-170 95-220*	>170 >220*
Cracking *(%)*	<5	5-10	>10
Rutting *(inches)*	<0.20	0.20-0.40	>0.40
Faulting *(inches)*	<0.05	0.05-0.15	>0.15

*Urbanized Population >1M

23 U.S.C. 119(e)(1), MAP-21 § 1106 - Subpart C (490.300s)

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MAP-21/FAST Bridge Performance Management

- Good/Fair/Poor measure based on NBI ratings
  - Use minimum of deck, superstructure, and substructure
  - Report conditions and targets for % good and poor for NHS bridges
- Additional goal of ≤10% of the NHS bridge deck area structurally deficient

NBI Rating Scale (from 0 – 9)		9 8 7 Good	6 5 Fair	4 3 2 1 0 Poor
Bridge	Deck (Item 58)	≥7	5 or 6	≤4
	Superstructure (Item 59)	≥ 7	5 or 6	≤ 4
	Substructure (Item 60)	≥ 7	5 or 6	≤ 4
	Culvert (Item 62)	≥ 7	5 or 6	≤ 4

23 U.S.C. 119(e)(1), MAP-21 § 1106 - Subpart D (490.400s)

MAP-21/FAST Transportation Asset Management Plan

- 10-year plan for NHS pavement and bridge assets using FHWA measures
- Required Contents:
  - ❑ Asset Management Objectives
  - ❑ Performance Measures and Targets
  - ❑ Summary Description of NHS Conditions
  - ❑ Performance Gap Identification
  - ❑ Life Cycle Planning
  - ❑ Risk Management Analysis
  - ❑ Financial Plan
  - ❑ Investment Strategies
- First TAMP due April 30, 2018

23 CFR Part 515.9 and 515.11

Workshop Purpose & Objectives

- Define the fundamental transportation objectives
- Develop and prioritize strategies to achieve the objectives
- Develop TAMP improvement plan ideas
- Discuss how best to work together to achieve NHS goals

California Transportation Asset Management Plan
Goals and Objectives Workshop

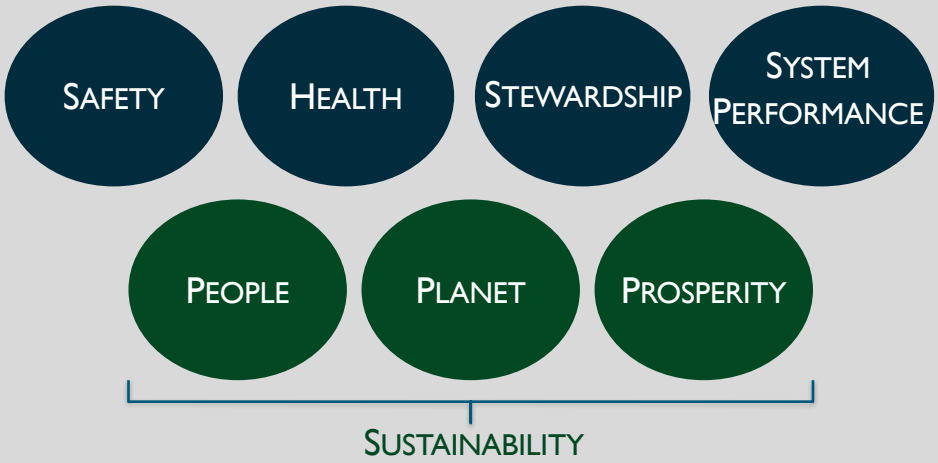
Exercise 1 – California Goals and Fundamental Objectives

December 15, 2016

Exercise Purpose

- Imagine where we want to be in the future
  - Guide our TAMP development process
- Build a common vision for goals and objectives
  - Work together to collectively make the vision come true
- Produce clearly articulated goals, fundamental objectives, strategies, and measures

Goal Areas

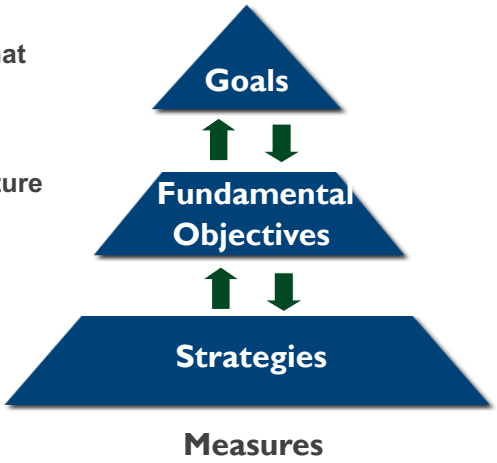


Exercise Components

Clear vision and direction for what we want to achieve together

Objectives are quantitative in nature and indicate how much improvement we'll achieve

Ways to attain the objectives – they are general approaches or methods



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Goals, Objectives and Measures

Goal	Fundamental Objective (Example)	Measure (Example)
Safety	Minimize transportation system fatalities	Number of fatalities
Safety	Minimize the number of transportation related injuries	Number of injuries
Safety	Minimize the severity of transportation related injuries	Average accident severity
Health	Maximize societal health by reducing emissions	Quantity of emissions (in tons by pollutant)
Stewardship	Maintain physical assets in a state of good repair	Difference between target and actual asset conditions
Stewardship	Minimize life cycle costs of ownership	Average asset life cycle cost
System Performance	Minimize inconvenience/lost economy due to travel delays	Reduced hours of delay
System Performance	Maximize travel time reliability	Buffer index
People	Maximize active transportation options	Percentage of trips with active transportation options available
Planet	Minimize environmental impacts from the transportation system	Land area and locations treated for water quality
Prosperity	Improve economic prosperity through efficient goods movement	Reduced hours of delay for truck traffic
Prosperity	Provide equitable transportation access for all modes	Quantity of multimodal elements constructed

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Exercise 1 - Strategies

DISCUSS the relationship between your assigned goal area, fundamental objectives, and example measures.

UPDATE the content for goals, fundamental objectives, and example measures.

DETERMINE STRATEGIES for achieving the fundamental objectives.

SELECT MEASURES to support your goal, objectives, and strategies.

Assign one person to record your discussion on the handout provided.
Be prepared to report out to the whole group.

Prioritize the Strategies

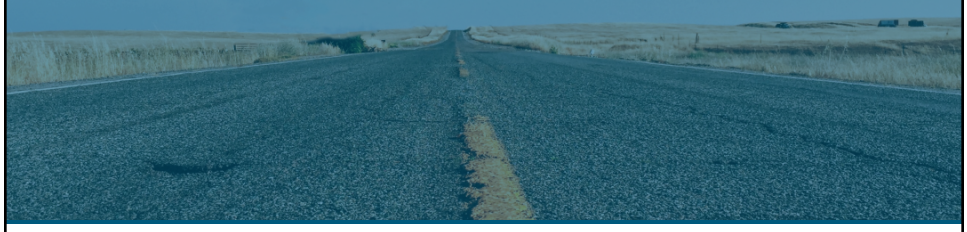
Use the colored dots to rank the **TOP THREE strategies (1=top choice)** for achieving the fundamental objectives.

1 2 3

Place your dots next to your selections for the best strategies.

California Transportation Asset Management Plan

Goals & Objectives Workshop



December 15, 2016

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California Transportation Asset Management Plan
Goals and Objectives Workshop

Vision – Examples of TAM Possibilities

National and International TAM Examples

December 15, 2016

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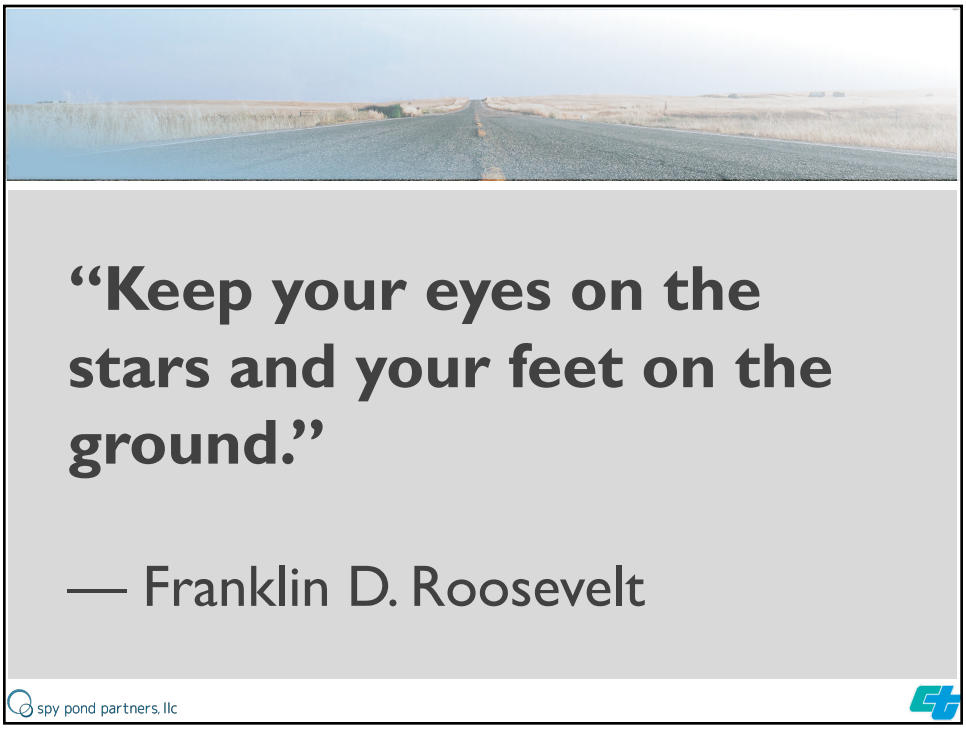

"Keep your eyes on the stars and your feet on the ground."

— Franklin D. Roosevelt

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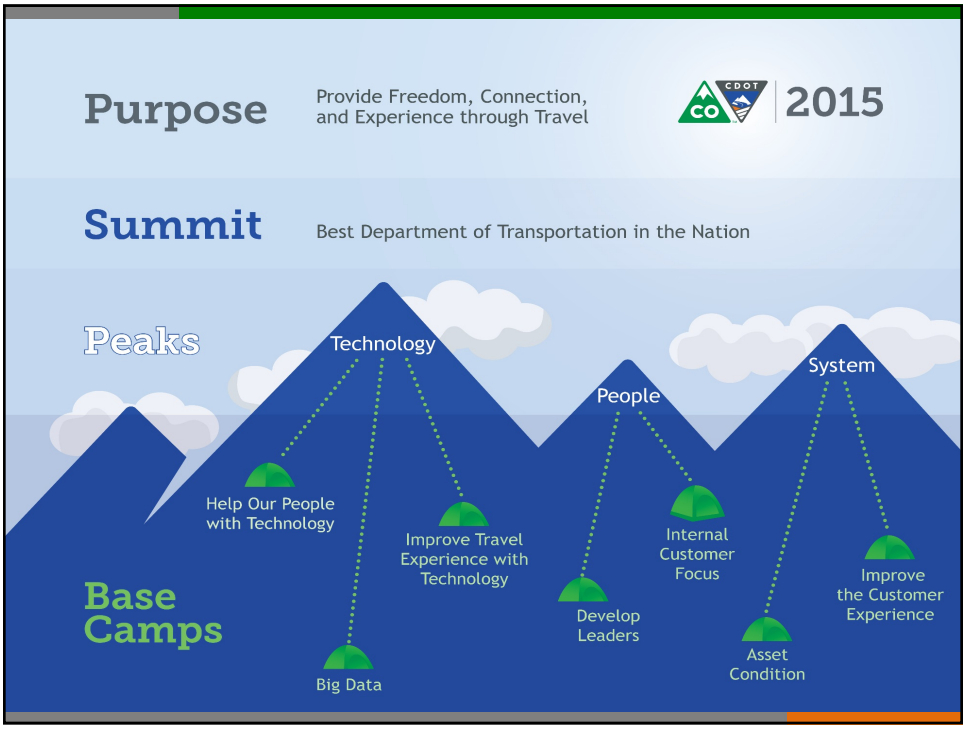
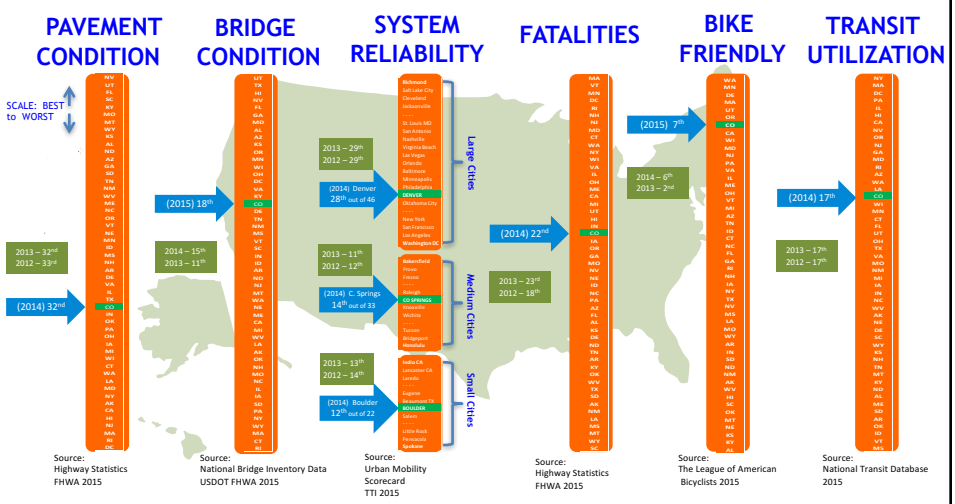


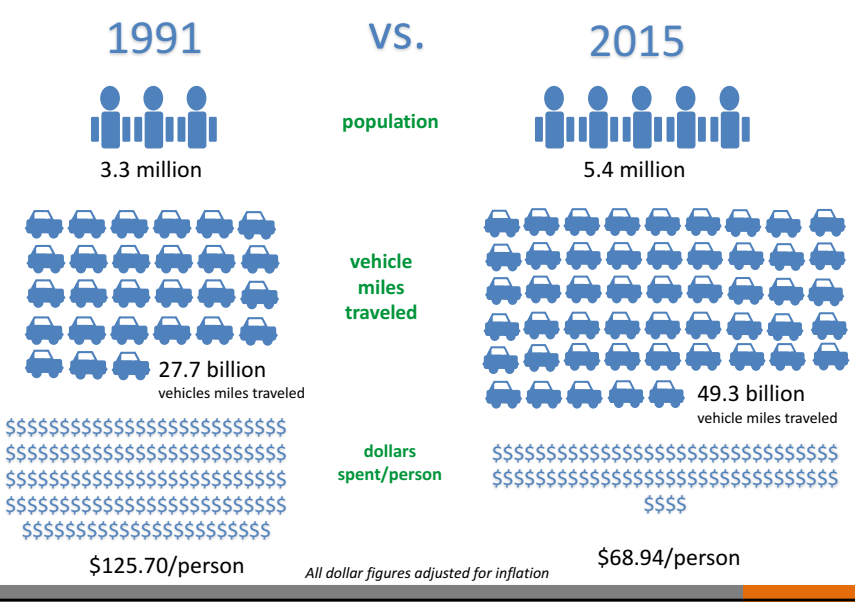
COLORADO
Department of Transportation

WHERE DOES COLORADO RANK?



COLORADO
Department of Transportation

THEN AND NOW
per capita spending



All dollar figures adjusted for inflation

COLORADO Department of Transportation

OUR CHALLENGE
continued growth

From 2013 to 2040

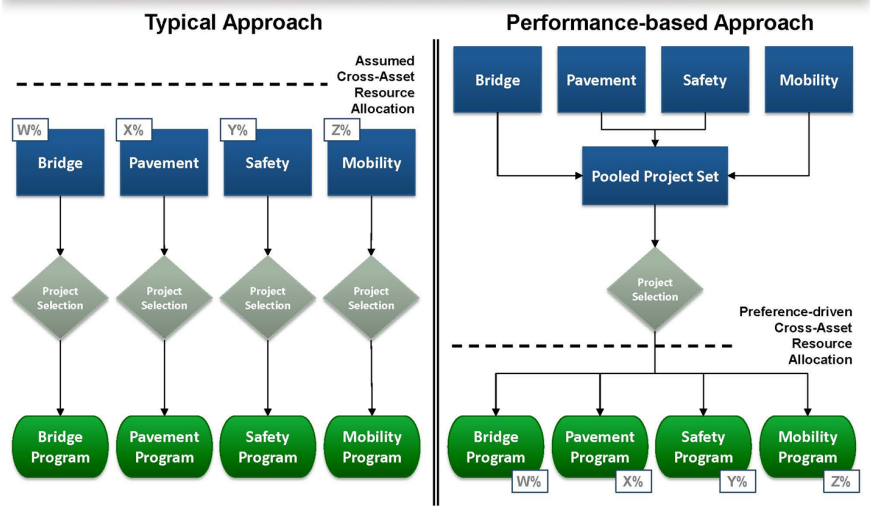
Population — +47% — 7.8 MILLION COLORADANS

Vehicle Travel — +47% — 41.8 BILLION MILES TRAVELED

Avg. Traffic Delay on congested corridors — 2 to 3 TIMES — DURING PEAK HOURS (if we do nothing)

COLORADO Department of Transportation

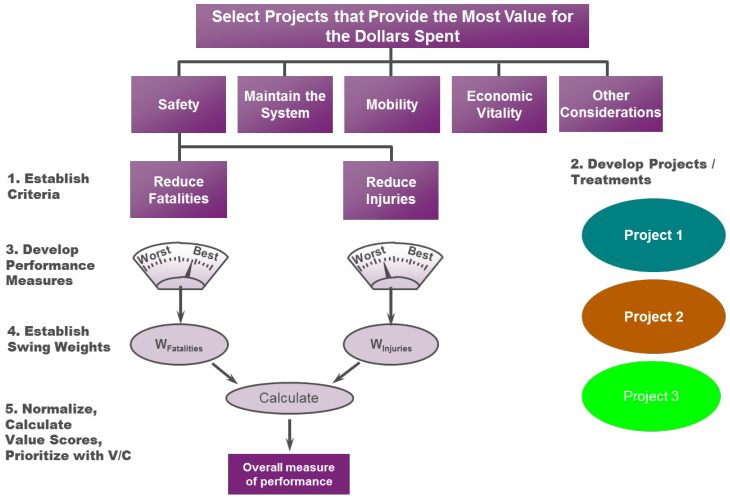
The Future
MODA



COLORADO Department of Transportation

MODA
How it Could Work

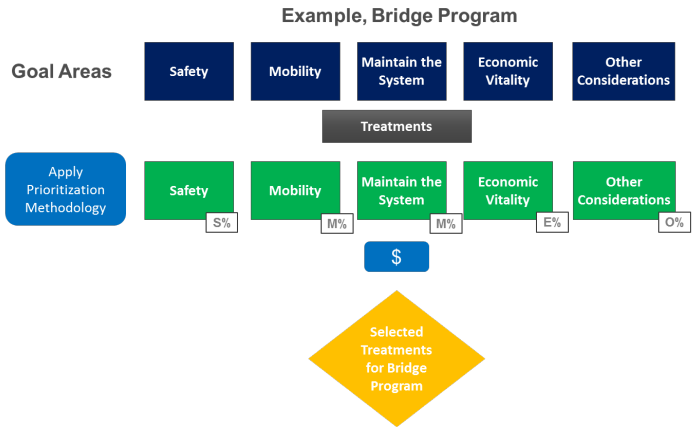
Prioritization Approach



COLORADO Department of Transportation

MODA
How it Could Work

Prioritization within specific program considering all goal areas



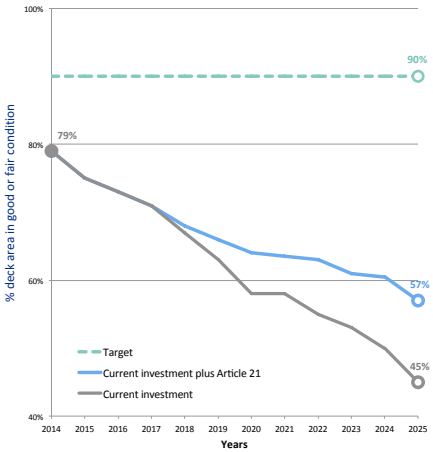
RI dot
Driven to get you there

Investing in Rhode Island's Future

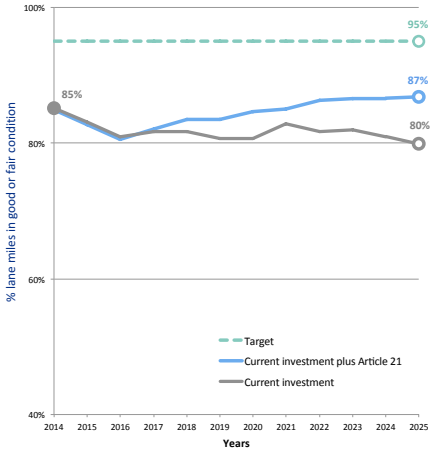
October 17, 2014

Managing our Decline

Bridge
% in good or fair condition

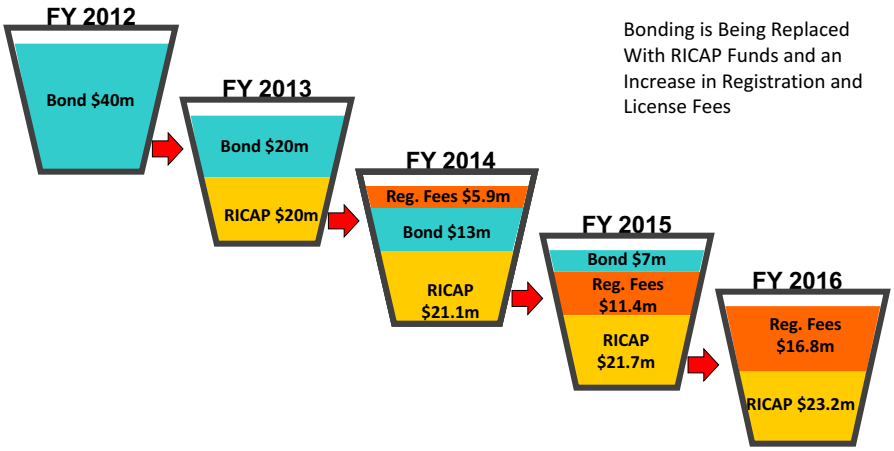


Pavement
% in good or fair condition



Investing in Rhode Island's Future

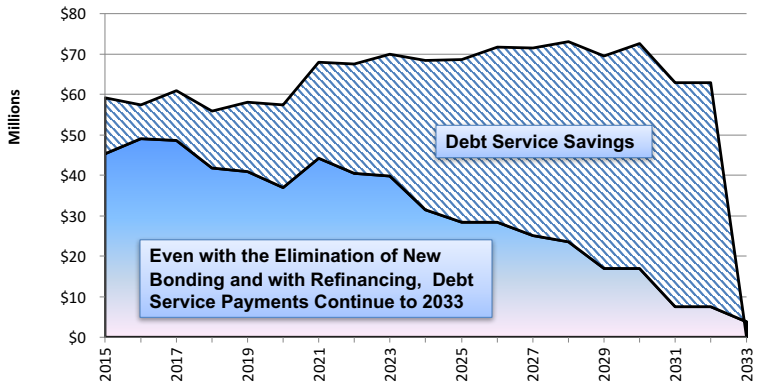
State Match Shift FY 2012 – 2016



Bonding is Being Replaced With RICAP Funds and an Increase in Registration and License Fees

Investing in Rhode Island's Future

State Match Shift = Reduced Debt Service



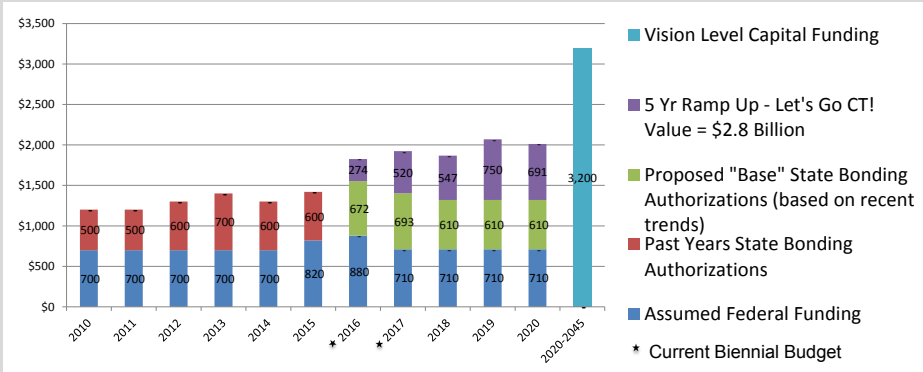
From 2015 to 2033 debt service has been calculated to be $578m

Best-in-Class Transportation System

Multi-Modal, Resilient, and Long Lasting

spy pond partners, llc

Strong Funding Foundation



"Connecticut needs a strong transportation lockbox" -Governor Malloy

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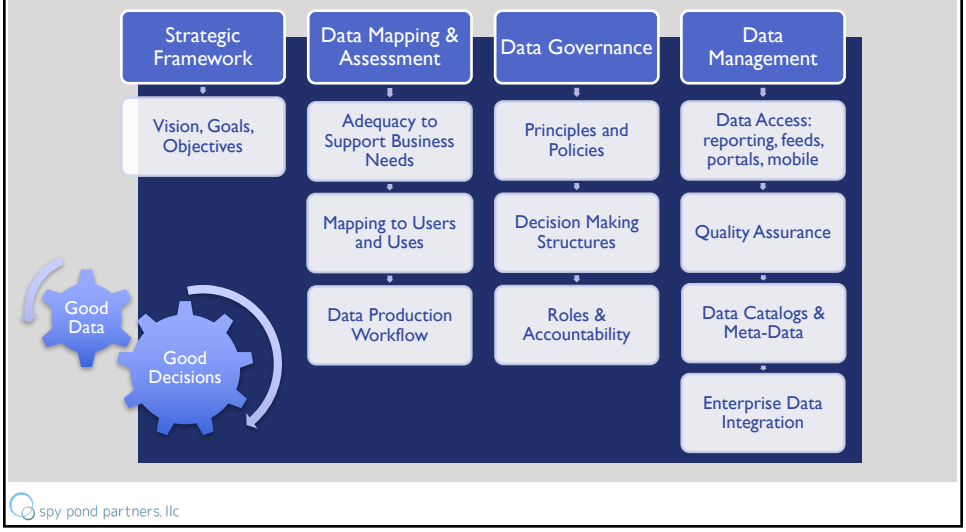
Data-Driven Decision Making



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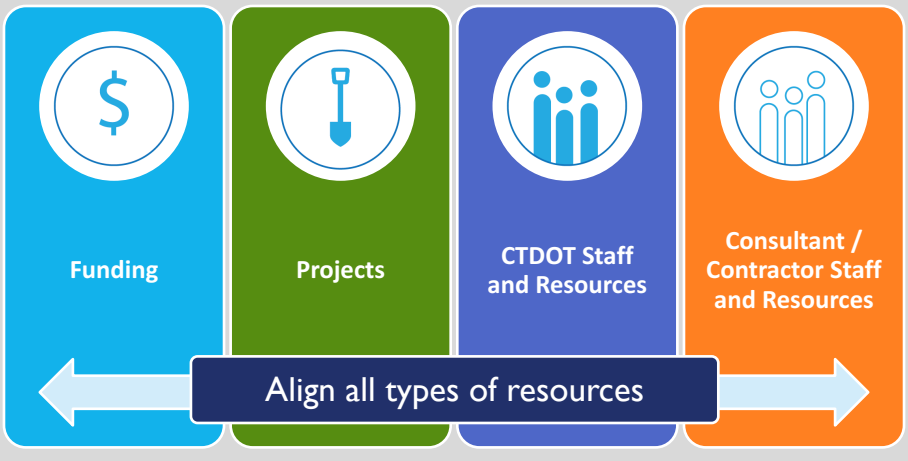
Whole Resource Model



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NMDOT Vision

One Team. One Vision. One Voice.

NMDOT Information Vision

Better Decisions, Better Relationships, Better Outcomes

Map-Based Information Portal

Customer-Oriented Web Portal

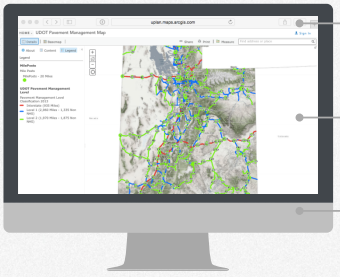
Integrated Asset Management Systems

Web-Centric TAMP

Self-Serve Data

Map-Based Information Portal

One-Stop Shop



1. **Quick and convenient access**
2. **Communicate with the Public**
3. **Share data across NMDOT units (GO and Districts) – connect the silos**

Mobile Tablet-Based Apps

Use an app to access timely and relevant information when meeting with an elected official

- **Show** historical trends in asset condition by geographic zones (i.e., elected official's district) by investments made or not made
- **View** past and future projects and the impact on transportation performance in specific geographic areas
- **Respond** to questions about project status

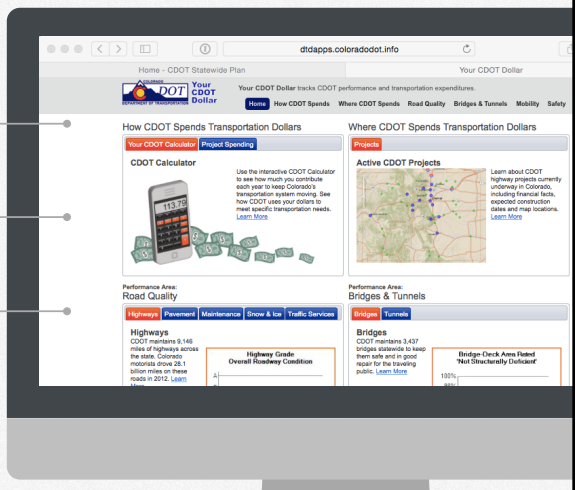
Customer Oriented Web Portal

Communicates Funding, Investments, Performance, and NMDOT Work

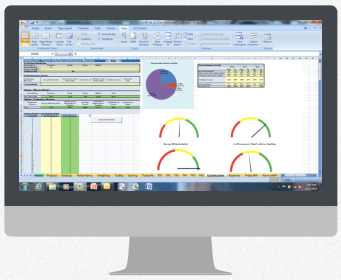
Projects 1

Performance 2

How taxpayer dollars are spent 3



Integrated Asset Management System



Tradeoffs
District x District.
Program x Program

Conduct Tradeoffs Across Programs and Geography

Where do we get the biggest bang for our buck?

Connect our strategic goals (long range plan) with resource allocation actions

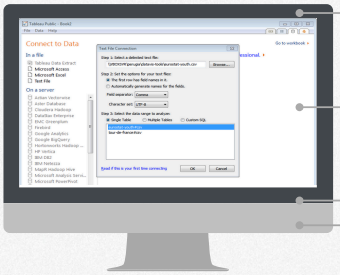
Need to balance issues – geographic equity, historical funding, risk, etc.

Web-Centric TAMP

- **Multi-lingual**
- **Interactive and Geographic**
- **Video**

Self-Serve Data

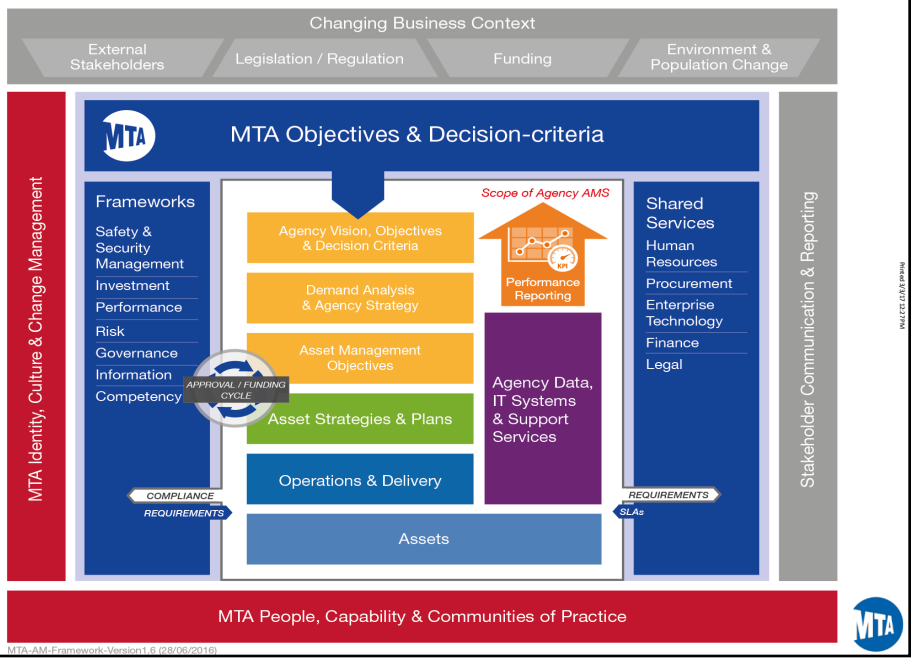
Making data available for:



1. **Download when needed**
2. **Generating your own reports**
3. **Mapping**
4. **Graphing**

25

MTA Asset Management Framework



MTA-AM-Framework-Version1.6 (28/06/2016)

Assessing Asset Management Capability

amcl asset management excellence model™

Strategy & Planning
- Asset Management Policy
- Asset Management Strategy & Objectives
- Demand Analysis
- Strategic Planning
- Asset Management Planning

Asset Information
- Asset Information Strategy
- Asset Information Standards
- Asset Information Systems
- Data & Information Management

Asset Management Decision-Making
- Capital Investment Decision-Making
- Operations & Maintenance Decision-Making
- Lifecycle Value Realisation
- Resourcing Strategy
- Shutdowns & Outage Strategy

Organisation & People
- Procurement & Supply Chain Management
- Asset Management Leadership
- Organisational Structure
- Organisational Culture
- Competence Management

Lifecycle Delivery
- Technical Standards & Legislation
- Asset Creation & Acquisition
- Systems Engineering
- Configuration Management
- Maintenance Delivery
- Reliability Engineering
- Asset Operations
- Resource Management
- Shutdown & Outage Management
- Fault & Incident Response
- Asset Decommissioning & Disposal

Risk & Review
- Risk Assessment & Management
- Contingency Planning & Resilience Analysis
- Sustainable Development
- Management of Change
- Assets Performance & Health Monitoring
- Asset Management System Monitoring
- Management Review, Audit & Assurance
- Asset Costing & Valuation
- Stakeholder Engagement

MTA

MnDOT Family of Plans

Minnesota GO 50-year Vision
What are we trying to achieve?

Statewide Multimodal Transportation Plan
How are we going to achieve it?

Modal and System Plans
What does that mean for each type of transportation?

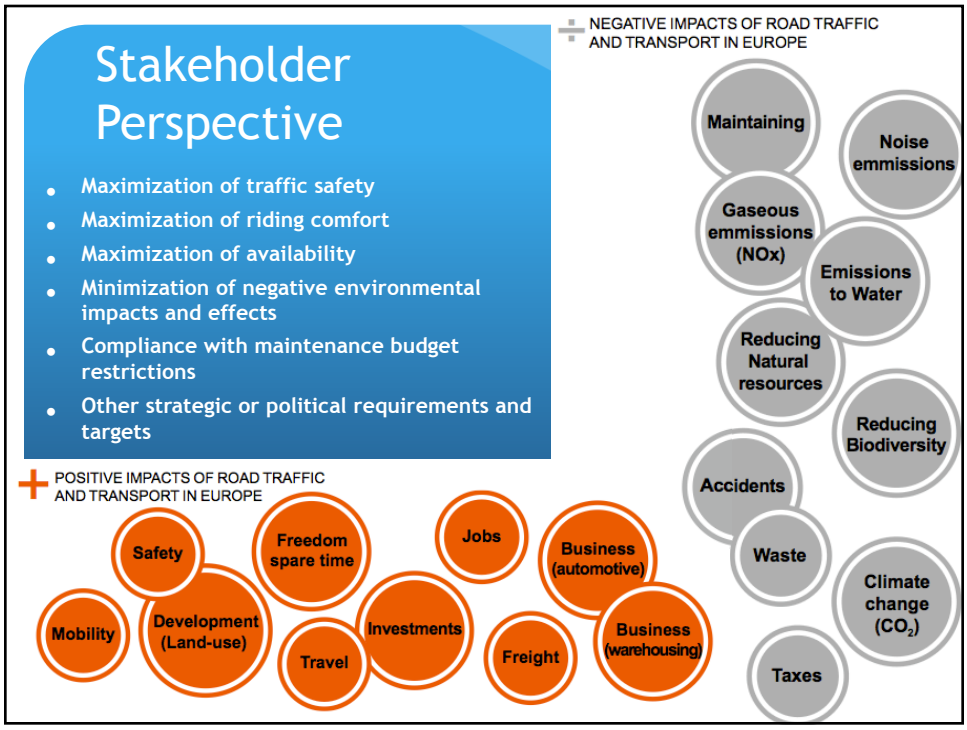
< Considered as part of the Highway Investment Plan >

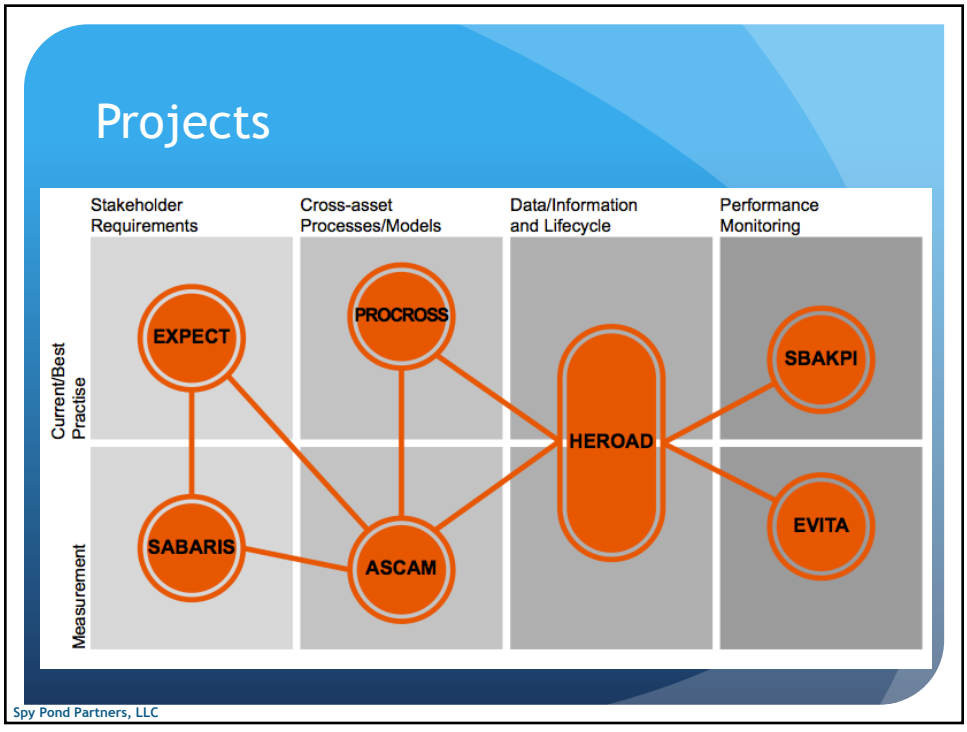
- Greater Minnesota Transit Investment Plan
- Pedestrian Plan
- Bicycle Plan
- State Highway Investment Plan
- Freight System Plan
- Aviation Plan
- Rail Plan
- Ports & Waterways Plan

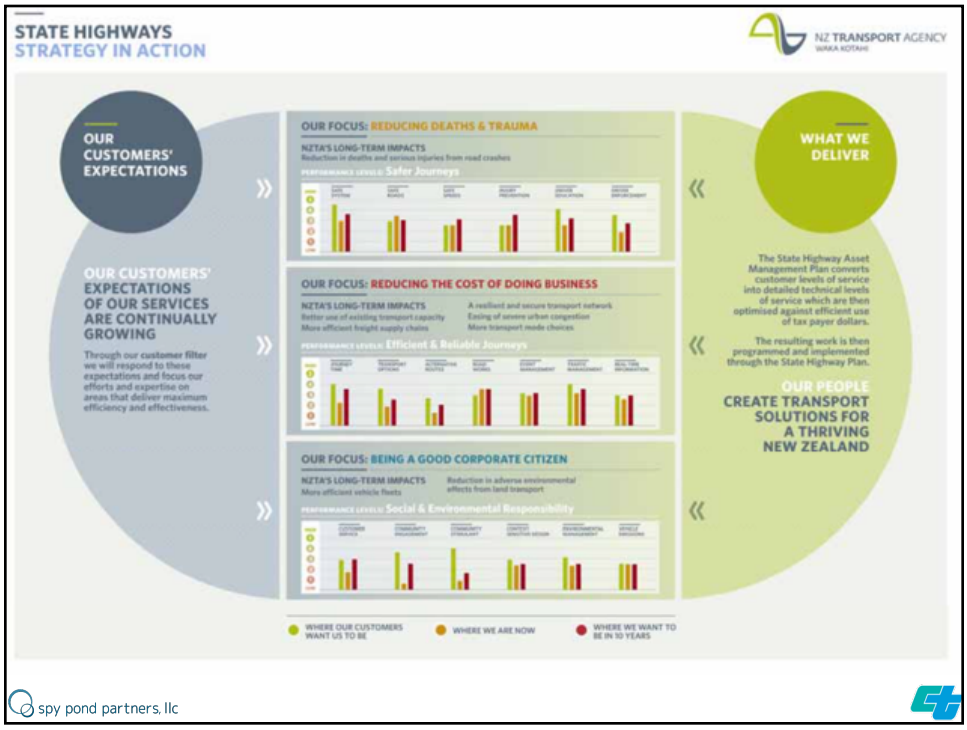
< Considered as part of the Freight System Plan >


Highway Planning Process
Policy Direction
Capital Plan
Capital Program
Implementation
Minnesota GO Vision and Statewide Multimodal Transportation Plan
State Highway Investment Plan (MnSHIP)
4-Year State Transportation Improvement Program (STIP)
Construction
Modal Programs
Maintenance and Operations
Transportation Asset Management Plan
Monitoring / Reporting / Adjustments (Annual Performance Report)


PROCROSS
SABARIS
EXPECT
HEROAD
SBAKPI
EVITA
ASCAM
Effective asset management meeting future challenges 2010-2013
SOCIAL BENEFIT REPORT
CEDR
road ERA net


Stakeholder Perspective
Maximization of traffic safety
Maximization of riding comfort
Maximization of availability
Minimization of negative environmental impacts and effects
Compliance with maintenance budget restrictions
Other strategic or political requirements and targets
NEGATIVE IMPACTS OF ROAD TRAFFIC AND TRANSPORT IN EUROPE
Maintaining
Noise emmissions
Gaseous emmissions (NOx)
Emissions to Water
Reducing Natural resources
Reducing Biodiversity
Accidents
Waste
Climate change (CO_2)
Taxes
POSITIVE IMPACTS OF ROAD TRAFFIC AND TRANSPORT IN EUROPE
Safety
Freedom spare time
Jobs
Business (automotive)
Mobility
Development (Land-use)
Travel
Investments
Freight
Business (warehousing)


Projects
Stakeholder Requirements
Cross-asset Processes/Models
Data/Information and Lifecycle
Performance Monitoring
Current/Best Practise
Measurement
EXPECT
PROCROSS
HEROAD
SBAKPI
SABARIS
ASCAM
EVITA
Spy Pond Partners, LLC



spy pond partners, llc

Driver	Response	Outcome(s)
Government direction		
A sharper and broader focus on value for money from the *Government policy statement*	Road Maintenance Industry Taskforce chaired by the NZTA	A programme of coordinated initiatives that will have a major impact on how we manage our business in the future through expected identified improvements
Letter of Expectation from the Minister	Professional Services Review Transport Planning Review Maintenance and Operations Review Project Life Cycle Review Other Headway projects	
External audit		
Office of the Auditor- General report on the NZTA: Information and planning for maintaining and	Coordinated improvement plan linked to identified areas of poor improvement	Improved use of asset information to make management decisions

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Goals x TAM Relationship

Goal	Ability to Impact Though Asset Investments	Example of Activities on Existing Assets Related to the Objective
Safety	High	Upgrading roadway safety features
Health	Low	Reducing pavement roughness
Stewardship	High	Determining and implementing cost-minimizing asset preservation strategies
System Performance	Medium	Improving performance of ITS devices
People	Low	Improving coordination with transit agencies on road projects
Planet	High	Incorporating environmental enhancements on road projects
Prosperity	Medium	Improving performance of ITS devices

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Exercise 2 – Improvements

Use the work from Exercise 1.

DISCUSS TAM-related actions that will support the goal, fundamental objective, strategies, and measures.

DEVELOP a list of TAM improvements.

Assign one person to record your discussion on the handout provided.
Be prepared to report out to the whole group.

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Prioritize TAM Improvements

Use the colored dots to rank the
TOP FIVE TAM improvements (1=top choice)

1 2 3 4 5

Place your dots next to your selections for the best TAM improvements.

Use the extra sticker to cast your vote for the “low-hanging fruit” improvement.

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California Transportation Asset Management Plan
Goals and Objectives Workshop

Wrap Up
Summary of Key Themes and Next Steps

December 15, 2016

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Key Themes

-
-
-
-
-

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Next Steps

2017

Winter	Spring	Summer	Fall

- Risk Management
- Financial Planning – Investment Strategies
- Improvement Planning
- TAMP Building

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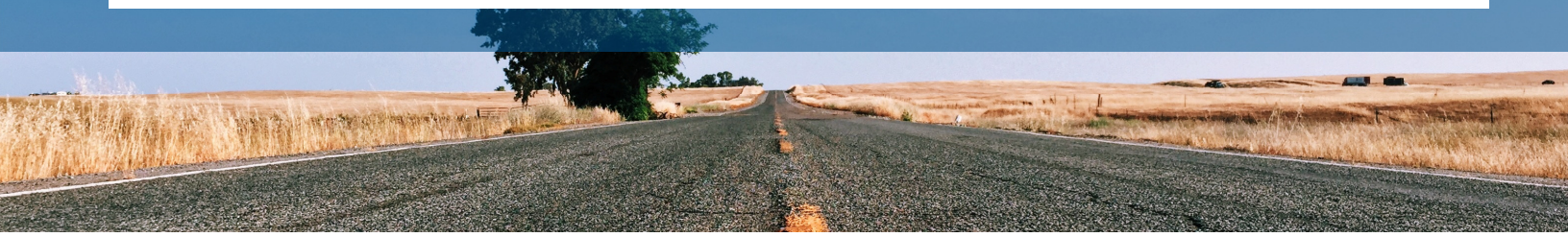
Appendix C – Workshop Handouts

December 15, 2016 • Holiday Inn Sacramento Downtown – Arena

Goals and Objectives Workshop



California Transportation Asset Management Plan

The Transportation Asset Management Plan (TAMP) will allow California to maximize results by managing the life-cycle of transportation assets strategically to minimize costs. It will provide a framework for understanding performance gaps, prioritizing actions to address the gaps, and establishing business processes that streamline asset management activities. It will also allow us to meet both federal and state legislative requirements.

Goals and Objectives Workshop

One of the first steps in developing the TAMP is to build agreement on our shared transportation objectives and the relative priority of these objectives. The Goals and Objectives Workshop on December 15, 2016 will bring together a cross section of stakeholders for this purpose. This interactive strategic session will result in a clearer more focused strategic direction including:

- Prioritize objectives for transportation asset management
- Share ideas on how best to achieve the goals and objectives
- Agree on what outcomes are desired
- Determine ways to measure progress
- Align the activities of the stakeholders
- Provide the foundation for the development of our TAMP

Key Activities

- Overview of transportation asset management requirements
- Small group exercise to develop goals, objectives, outcomes, and measures
- Define our collective transportation goals and objectives
- Prioritization of objectives and outcomes
- Future vision with transportation asset management

Attendance

December 15, 2016
10:00 a.m. to 3:00 p.m.

Holiday Inn Sacramento
Downtown – Arena
300 J Street, Sacramento

Invited attendees should RSVP to:
SHOPP.Management@dot.ca.gov

Due to the size limitation of the workshop space, only invited participants or their designees can be accommodated.

A summary report with the results and contents of the workshop will be shared with all stakeholders.

Questions?

Email
SHOPP.Management@dot.ca.gov
to learn more.

Caltrans TAMP – Goals & Objectives Workshop – Exercise 1
Your Assigned Goal Area: _____

California Goals and Fundamental Objectives

Assign a scribe and a reporter for your group.

For your goal area, review the resource page that is included in the last section of this handout and discuss the following:

1. Discuss the relationship between your assigned goal area, fundamental objectives, and example measures

2. Update the content for goal, fundamental objectives, and example measures, if needed

3. Determine strategies for achieving the fundamental objectives
   - Consider all types of strategies
   - Note those that have a direct relationship to TAM

4. Select measures that support your goal, objectives, and strategies

Exercise Input Form

1. Discuss the relationship between your assigned goal area, fundamental objectives, and example measures

2. **Update the content for goal, fundamental objectives, and example measures, if needed**

3. **Determine strategies for achieving the fundamental objectives**
   - Consider all types of strategies
   - Note those that have a direct relationship to TAM (put X in column on right)

Strategy	TAM
Strategy 1	
Strategy 2	
Strategy 3	

Strategy	TAM
Strategy 4	
Strategy 5	
Strategy 6	

4. Select measures that support your goal, objectives, and strategies

ASSET MANAGEMENT FACTS

California Transportation Asset Management Plan

First Small Group Exercise

Health Goal

The Health Goals broadly recognize the societal benefit from having more healthy transportation modes. The benefits of healthier transportation options may include items similar to the following:

- Reduced societal medical care cost
- Improved air quality from reduced emission
- A healthier more productive society

Examples of potential fundamental objectives

- Maximize societal health by providing healthy transportation options

Example of potential measures

- Table to identify measure(s)

ASSET MANAGEMENT FACTS

California Transportation Asset Management Plan

First Small Group Exercise

Sustainability Goal – People

The sustainability goal can be split into three distinct areas (people, planet and prosperity). This team will focus only on the People portion of sustainability. The People portion of sustainability deals with improving the quality of life for the people of California.

Topics to consider in this area include:

- Transportation modal choice
- Accessibility
- Social Equity

Example of potential fundamental objectives

- Maximize active transportation options

Example of potential measures

- Percentage of trips with active transportation options available

ASSET MANAGEMENT FACTS

California Transportation Asset Management Plan

First Small Group Exercise

Sustainability Goal – Planet

The sustainability goal can be split into three distinct areas (people, planet and prosperity). This team will focus only on the Planet portion of sustainability. The Planet portion of sustainability focuses on the transportation impact on the environment.

Topics to consider in this area include:

- Impacts on plant and wildlife
- Impacts on air and water quality
- Noise pollution
- Utilization of recycled materials

Example of potential fundamental objectives

- Minimize environmental impacts from the transportation system

Example of potential measures

- Land area treated for water quality

ASSET MANAGEMENT FACTS

California Transportation Asset Management Plan

First Small Group Exercise

Sustainability Goal – Prosperity

The sustainability goal can be split into three distinct areas (people, planet and prosperity). This team will focus only on the Prosperity portion of sustainability.

The Prosperity portion of sustainability focuses on the following types of items:

- Transportation system resiliency (fire, flood, earthquake, etc.)
- Freight system competitiveness

Example of potential fundamental objectives

- Improve economic prosperity through efficient goods movement

Example of potential measures

- Reduced hours of delay for truck traffic

ASSET MANAGEMENT FACTS

California Transportation Asset Management Plan

First Small Group Exercise

Safety Goals

The Safety Goal deals with all modes of transportation safety.

The following statistics are from the 2012-2014 time period as published in the *Strategic Highway Safety Plan, and* may help frame the Transportation Asset Management Plan (TAM) discussion:

- 32% of all fatalities or severe injury involved an impaired person
- 23% of all traffic related fatalities and severe injuries involved a vehicle leaving the road and striking an object or crossing over the center divider and causing a head on collision.
- 18% of all fatalities or severe injury involved speeding or aggressive driving
- 17% of fatalities or severe injury accidents involved pedestrians.
- 12% of fatalities or injuries involved an improperly used occupant restraint device (seat belt, car seat)
- 1.7% of all fatalities or severe injuries happened in construction work zones

Example of potential fundamental objectives

- Minimize the number of transportation related fatalities

Example of potential measures

- Count of fatalities over a time period

ASSET MANAGEMENT FACTS

California Transportation Asset Management Plan

First Small Group Exercise

Stewardship Goal

The Stewardship Goal focuses primarily on the maintenance, rehabilitation and renewal (replacement) of physical infrastructure assets. Assets include: pavement, bridges, culverts, traffic management systems, signs, lighting, maintenance facilities, office buildings, traffic management centers, transportation laboratories, equipment shops, pump plants, roadside rest areas, emergency repairs and relinquishments.

Specific topics to be considered include:

- Asset condition
- Life cycle cost of ownership
- Assigning assets to the appropriate governmental ownership party

Examples of potential fundamental objectives

- Maintain physical assets in a state of good repair
- Minimize life cycle costs of ownership

Examples of potential measures

- Difference between target and actual asset conditions

ASSET MANAGEMENT FACTS

California Transportation Asset Management Plan

First Small Group Exercise

System Performance Goal

The system performance goal focuses on how well the transportation system functions.

System performance could be expressed in terms of the following items:

- Travel time reliability
- Reduction in travel delay experienced
- On time operation for transit components
- Facilities for bike and pedestrian modes (Complete Streets)
- Traveler information system presence/operation
- Promotion of multi-occupant vehicle trips

Example of potential fundamental objectives

- Minimize inconvenience/lost economy due to travel delays
- Maximize travel time reliability

Example of potential measures

- Reduced hours of delay

Caltrans TAMP – Goals & Objectives Workshop – Exercise 2
Your Assigned Goal Area: _____

California Goals and Fundamental Objectives

Assign a scribe and a reporter for your group.

For your goal area, start with your work from Exercise 1 – goals, fundamental objectives, strategies, and measures.

1. Discuss TAM-related actions that will support the goal, fundamental objectives, strategies, and measures
2. Develop a list of TAM improvements that the group recommends

Exercise Input Form

1. **Discuss TAM-related actions that will support the goal, fundamental objectives, strategies, and measures (use the space below for your notes)**

2. Develop a list of TAM improvements that the group recommends

Improvements
Improvement 1
Improvement 2
Improvement 3
Improvement 4
Improvement 5
Improvement 6